U.S. ATLAS M&O Estimate
WBS Dictionary

WBS Number	Description
3.1	**Silicon**
	Pre-operations, operations and maintenance of the silicon subsystem(pixels, SCT and RODs).

WBS Number	Description
3.1.1	**Pixels**
	Pre-operations, operations and maintenance for the pixel subsystem.
3.1.1.1	**Pre-operations**
	Pre-operations
3.1.1.1.1	**SR Building Facilities**
	Preparation of SR building for pixel-specific tasks.
	Comments: Funding for materials, equipment and related items for the SR building are covered under WBS 3.1.4 to be in common with the SCT(and TRT).
3.1.1.1.2	**Mechanical support**
	Design and other activity related to preoperations of pixel detector.
	Comments: Mechanical engineering, design and technical support. Engineer at 1 FTE in FY06. 0.25 FTE designer in FY06. 1 FTE technical in FY06. Travel is included for this team. Costs for small items are also included.
3.1.1.1.3	**Electrical support**
	Support of electronics preoperations, test systems, pixel-specific work on RODs.
	Comments: Our model assumes a continuation of systems engineering support after completion of the IC and off detector electronics system fabrication at 1.0 FTE in FY06 Travel costs are included. We also include costs for electronics test equipment that will be used at CERN for extended periods.
3.1.1.1.4	**Software support**
	Support of software systems for preoperations.
	Comments: Software support of electronics, DAQ, monitoring, calibration by John Richardson..

WBS Number	Description
3.1.1.1.5	**Physicist support**
	Physicist support of preoperations and commissioning.
	Comments: Currently ascribed all to LBNL for convenience, but includes LBNL and all universities. Division among LBNL and universities is TBD.
3.1.1.2	**Operations**
	Operations during ATLAS data taking.
3.1.1.2.1	**Mechanical Support**
	Mechanical support of operations.
	Comments: 0.5 FTE ME in FY07-FY08, assuming need for intervention(partial or complete pixel removal) and 0.1 FTE thereafter to be available to answer questions, address problems.. We assume 0.5 FTE tech equivalent support for operations is required and miscellaneous materials and equipment costs.
3.1.1.2.2	**Electrical Support**
	Support of electronics operations
	Comments: 0.25 FTE EE in FY07 -FY08, which assumes need for intervention, fixing problems… and 0.1 FTE thereafter. Technical support at 0.25 FTE in FY07-FY08 and then 0.1 FTE thereafter.
3.1.1.2.3	**Software support**
	Support of software for operations.
	Comments: 1 FTE computer scientist/engineer, John Richardson for operation, maintenance of DAQ, software, calibration and related electronics systems.
3.1.1.2.4	**Physicist support**
	Physicist support of operations.
	Comments: Currently all ascribed to LBNL for convenience but includes LBNL and university physicists. Division among LBNL and specific universities is TBD.
3.1.1.3	**Maintenance**

WBS Number	Description
	Maintenance activities during ATLAS shutdowns.
3.1.1.3.1	**Mechanical support**
	Mechanical support of maintenance
	Comments: 0.5 FTE ME in FY07-FY08, 0.25 FTE thereafter. 0.5 FTE technician. Travel and misc expenses
3.1.1.3.2	**Electrical support**
	Electrical engineering and technical support of maintenance.
	Comments: 0.25 EE in FY07-FY08, 0.1 FTE thereafter. Technical support at 0.5 FTE in FY07-FY08, 0.25 FTE thereafter. Travel and misc expenses
3.1.1.3.3	**Software support**
	Software support of maintenance
	Comments: Covered under operations.
3.1.1.3.4	**Physicist support**
	Physicist support of maintenance.
	Comments: Covered under operations
3.1.1.3.5	**Spares**
	Spare items and parts. By definition these are not included in the initial fabrication or procurements.
	Comments: Currently no spares are foreseen, since early upgrade is projected.

WBS Number	Description
3.1.2	**SCT**
	Pre-operations, operations and maintenance for the SCT subsystem.
3.1.2.1	**Pre-operations**
	Pre-operations
	Comments: LBNL and UC Santa Cruz are currently the only US institutions involved in the SCT. We have made an estimate of the division of costs between these two in the subsequent lower levels, but it's the sum that is most relevant.
3.1.2.1.1	**Preoperations - LBNL**
	Physicist and technical staff for preoperations and commissioning
	Comments: Support of engineering personnel FY05 and FY06 to provide support related to macro-assembly to preoperations and commissioning activities in the UK and at CERN. This includes documentation. Travel and misc expenses.
3.1.2.1.2	**Preoperations - UCSC**
	Physicist and technical staff for preoperations
	Comments: EE in FY05 and 100% of FY06 for work on grounding, shielding, responding to questions regarding UCSC deliverables and other preoperations activities. trips per year to Europe are included. Technician related to preoprations in UK and CERN, responding to questions about UCSC deliverables and other preoperations activities. Travel and misc expenses.
3.1.2.1.3	**Preoperations - SR building/CERN**
	Costs associated with SCT operation in SR building and other assembly/test sites at CERN.
	Comments: These costs are covered under 3.1.4 as part of Common Silicon/ID costs
3.1.2.2	**Operations**
	Operations during ATLAS data taking.
3.1.2.2.1	**LBNL**

WBS Number	Description
	Physicist and technical staff for operations.
	Comments: 0.25 FTE technical support in FY07, thereafter is covered under UCSC element.
3.1.2.2.2	**UCSC**
	Operations support at UCSC
	Comments: 0.25 FTE EE in FY07, 0.1 FTE thereafter. 1 FTE technical support as part of the SCT technical pool.
3.1.2.2.3	**SR building/CERN**
	Operations support for SCT at CERN
	Comments: These are covered under 3.1.4.
3.1.2.3	**Maintenance**
	Maintenance activities during ATLAS shutdowns. This also includes preparations for maintenance.
	Comments: Spares are included in this element. We assume 15% spares are required. Routine maintenance operations on the SCT are covered under operations. We assume two interventions, the first in FY07 for 6 months for "minor" repairs and a major intervention for one year in FY11(arbitrary). Technical labor is arbitrarily assigned only to UCSC at this time.
3.1.2.3.1	**Spares**
	Spare items and parts. By definition these are not included in the initial fabrication or procurements. We assume that 15% spare parts/assemblies are needed. The likely like of ability to procure critical parts(ABCD ICs) beyond end of 2003, we assume that spare parts(ICs, hybrids, detectors, baseboards) are procured in time to produce 15% spare modules at the end of the construction period i.e. in FY04.
3.1.2.3.2	**Manpower/materials**
	Manpower and materials for maintenance
	Comments: We assume normal operations and minor maintenance manpower is covered under operations. Manpower and materials here are for significant interventions, which we assume will occur in FY07(to fix problems seen in first run) and then again in FY11 for a major intervention to likely replace modules(spares). US maintenance expenses(apart from contribution to common pool) are included here.

WBS Number	Description
3.1.3	**RODs**
	Pre-operations, operations and maintenance for the RODs.
3.1.3.1	**Pre-operations**
	Pre-operations.
	Comments: Wisconsin, Iowa State and LBNL are currently the institutions involved in the RODs. The division of labor and materials at lower levels is a best estimate at this time of the division among these institutions, but the sum is the more relevant number.
3.1.3.1.1	**Wisconsin**
	Support of RODs in use for macro assembly testing before 1st collisions and at CERN for commissioning.
	Comments: 1 FTE EE support for responding to problems, VHDL support. SCT ROD fabrication is planned to be completed in FY02, pixel fabrication in FY03. Travel and misc expenses. Licenses are included.
3.1.3.1.2	**LBNL**
	Support of RODs in use for macro assembly testing and for commissioning
	Comments: 0.25 FTE of software support for pixel/SCT-specific code.
3.1.3.1.3	**Iowa State**
	Support of RODs in use for macro assembly testing before 1st collisions and for commissioning
	Comments: Physicist manpower only
3.1.3.2	**Operations**
	Operations during ATLAS data taking.
	Comments: Wisconsin, Iowa State and LBNL are currently the institutions involved in the RODs. The division of labor and materials at lower levels is a best estimate at this time of the division among these institutions, but the sum is the more relevant number.
3.1.3.2.1	**Wisconsin**

WBS Number	Description
	Operations support via Wisconsin
	Comments: 1FTE EE support in FY07, 0.5 FTE in FY08, dropping to 0.1 FTE thereafter. Travel and misc expenses.
3.1.3.2.2	**LBNL**
	LBNL operations support
	Comments: 0.25 FTE computer scientist/engineer in FY07 dropping to 0.1 FTE thereafter.
3.1.3.2.3	**Iowa State**
	Iowa State operations support
	Comments: Physicists only
3.1.3.3	**Maintenance**
	Maintenance activities during ATLAS shutdowns. This also includes preparations for maintenance.
	Comments: Spares. 0.25 technical support ascribed to Wisconsin. Physicist labor covered under operations.
3.1.3.3.1	**Spares**
	Spare items and parts. By definition these are not included in the initial fabrication or procurements.
	Comments: We assume about 15% spares are needed. Scaled from current estimate as lump sum.
3.1.3.3.2	**Personnel/materials**
	Personnel and materials for maintenance operations.
	Comments: 0.25 technical support ascribed to Wisconsin. Physicist labor covered under operations.

WBS Number	Description
3.1.4	**Common Silicon/ID**
	Pre-operation, operations and maintenance for the common silicon or ID activities.
	Comments: Estimates are derived from CERN estimates assuming US silicon is 14% of total costs(without spares). This includes both pixel and SCT support of SR building, infrastructure, maintenance and operations.
3.1.4.1	**Pre-operations**
	Pre-operations before first LHC collisions.
	Comments: Based on estimates done by ID project leader and ATLAS. Ascribed here to LBNL.
3.1.4.2	**Maintenance Operations**
	Maintenance and operations during ATLAS data taking and beam off periods
	Comments: Estimates derived from those made by ID Project Leader and ATLAS. Both Pixels and SCT are covered here.